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INTERNATIONAL GEOPHYSICAL COOPERATION PROGRAM -- SOVIET-BLOC ACTIVITIES

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I. GENERAL

Geophysical Investigations in Marine Geology

The study, by geophysical methods, of the structure and evolution of the Earth's crust in the region of the world ocean is one of the most important problems of marine geology. Together with the over-all investigations of the structure of the Earth's crust by geophysical methods in remote parts of the world ocean, more detailed geophysical works in exploring and prospecting for petroleum deposits and sometimes in connection with the solution of engineering-geological problems are conducted in the region of the continental shelf.

The state and the possibility of magnetic, gravitational, electric geophysical prospecting and seismic works at sea are described in an article by V. V. Fedynskiy, which includes examples of the fulfillment of these works in the Soviet Union during recent years.

Aerial magnetic surveying in the USSR has been conducted over the Caspian, Azov, and Okhotsk seas and also over the Pacific Ocean. Airborne magnetometers with continuous registration were used for this purpose. The AEM-49 and ASGM-25, airborne magnetometers with ferromagnetic elements, are mounted in bimotored airplanes with towing gondolas. The change in the module of the full vector intensity of the geomagnetic field ΔT_a is measured with an error of $\pm$ 5-10 gammas. Observations are conducted at flight altitudes of 500-3,000 meters along courses 20-25 kilometers apart. Coordinate determination is accomplished by tying-in to shore bearings. The over-all error of the survey, according to discrepancies in the closed contours, is estimated at $\pm$ 30 gammas. Such surveying made it possible to compile small-scale charts of magnetic anomalies.

The experience of aeromagnetic operations over the sea indicates the close connection of magnetic anomalies with the basic characteristics of the tectonics of the earth's crust on a regional, as well as on a local, scale.

Modern magnetic apparatus with magnetically-saturated transducers are used aboard the Soviet nonmagnetic ship Zarya in making a world magnetic survey according to the IGY program.

Gravimetric works at sea are conducted with the aid of pendulums and gravimeters on board ships and also with bottom gravimeters. Large seagoing ships or submarines make it possible to measure the force of gravity at any depth with the low accuracy of $\pm$ 3-15 milligals.

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The first observations in the USSR according to the Vening-Meinesz method were made in the Black Sea in 1930. Since that time, pendulum observations have also been conducted in the Arctic basin, the Caspian Sea, the Pacific Ocean, and other areas.

In 1955, for shipboard measurements, a highly-damped quartz gravimeter (VNIIGeofizika) [All-Union Scientific Research Institute of Geophysics] was used for the first time. The system of this gravimeter is unsatisfactory for this purpose because it reacts too slowly to acceleration disturbances present on ships. Experimental observations with gravimeters housed in a gimbal were found to be in fully satisfactory agreement with the results of measurements made with pendulums.

A damped gravimeter was used with great success in the Okhotsk Sea, where, under large accelerations of the ship, measurements showing a mean square error of $\pm$ 3 milligals, i.e., possessing an accuracy equal to the best sea pendulum measurements, were obtained.

The use of gravimeters on board ships for marine gravimetric surveying is one of the most pressing research problems of the day. At the 11th General Assembly of the International Union of Geodesy and Geophysics, it was revealed that the USSR, US, West Germany, Canada, and Japan have developed gravimeters for shipboard observations. The Graf sea-gravimeter developed by West Germany is considered of great interest.

The problem of systematic errors in observations on board ships, especially surface ships, which are frequently subject to heavy rolling, merits special attention. Gravity observations were conducted with pendulums on board ships and with bottom gravimeters in one and the same part of the Caspian Sea. The gravimeter readings obtained can be considered free from systematic errors. A comparison shows that the observations on board the surface ships give inferior results. Vertical accelerations have a predominant influence, as a result of which the difference between the gravimeter and pendulum determinations consist of about + 20 milligals and sometimes even more. Control observations with bottom gravimeters make it possible to effect appropriate corrections in the results of gravimeter determinations on board ships.

Gravimetric observations in the Pacific Ocean show an increase of Bouguer anomalies of 200-300 milligals in the transition from the Okhotsk Sea to the deep water oceanic depressions. This change of gravity anomaly is explained by an increase of approximately 35 kilometers in the thickness of the granite-basalt layer of the Earth's crust under the Asiatic continent.

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East of Kamchatka, latitudinal extensions of gravitational anomalies along the Aleutian ridge are noted. In the Okhotsk Sea, the gravitational field is heterogeneous. Maximums here indicate the presence of oceanic-type portions of the crust, whereas minimums correspond to regions of modern geosynclinal flexures. Gravity anomalies of the Kurile-Kamchatka zone are closely connected with numerous earthquake foci located here, as well as with the chain of volcanoes in this zone.

The over-all gravimetric survey of the Caspian Sea gives a tectonic regioning which is in good agreement with the results of aeromagnetic works.

Some systems of bottom instruments with remote control and the ability to make gravimeter readings on board ship were built in the USSR for detailed gravimetric work in shallow seas. Such instruments were developed in VNIIGeofizika (All-Union Scientific Research Institute of Geophysics). These can be used in comparatively small ships.

Bottom gravimeters are placed on the sea bottom in a cardan suspension. Observations are limited to depths up to 100 meters. Detailed operations near the Apsheronskiy peninsula and the shores of the Turkmen SSR were conducted with bottom gravimeters in prospecting for petroleum. The observations made it possible to trace the principal tectonic elements of the Balkhansk depression and the Apsheronskiy peninsula in the sea and to note the specific maximums connected with the heavy nuclei of diapirs from mud volcanoes.

Electric geophysical exploration operations, with the use of a dipole sounding method, have been used since 1954 in the Caspian Sea. These observations are conducted with two or more ships, one of which contains the generating equipment and the remainder -- the receiving apparatus. Distance between ships can vary from 500 meters to 2 kilometers. Studies down to a depth of 200 meters is considered possible. At greater depths, the resolving capability of marine-dipole electric sounding is lowered sharply.

The principal value of marine electric prospecting is that it substantially supplements the results of seismic prospecting work. The electrical resistance of the layers of the Earth's crust under the sea bottom gives certain presentations on their lithological composition. Electric geophysical prospecting characterizes the structure of areas where seismic prospecting, untill now, has been without results, for example, in the exposed parts of buried anticlinal structures.

Seismic prospecting by means of reflected waves is the best method for studying the nature of folding of sedimentary rock in maritime regions and for seeking anticlinal structures favorable for the accumulation of petroleum and gas. In this method of seismic prospecting, the gravimeter, enclosed in a hermetically-sealed container, is suspended above the sea bottom and is connected by wires to the seismic station aboard a ship. This method is not without its difficulties. High-frequency (50-200 cycles), irregular oscillations, especially intensive in certain parts of the sea, appear directly after the first arrival of seismic waves and very slowly weaken with time. These are called reverberation disturbances. The reception of reflections from the levels being studies are greatly hampered by the reverberation disturbances.

Particularly intensive marine-seismic reverberations arise when the bottom of the basin is bedded with dense rock having high reflecting capabilities. It has been experimentally shown that in the region near an explosion, high-frequency seismic reverberations arise as a result of repeated reflections of elastic oscillations from the water air boundary and the bottom. In addition, reverberations can arise as a result of the scattering of elastic oscillations within the boundaries of these media at a considerable distance from the explosion.

Two components with different frequency were detected by means of frequency analysis of marine-seismic reverberations. The frequencies of reverberations differ from the frequencies of a reflected signal. The harmful action of reverberatory seismic disturbances can be lessened considerably with the aid of special filters in seismic amplifiers and also by grouping the seismic receivers.

In 1954, piezo-crystal seismic receivers were used for the first time. Because of their small size and low weight, this type of receiver can be easily arranged inside an oil-filled chlorovinyl hose. The specific weight of the oil-filled hose is about equal to the specific weight of the sea water. Cross connections are also situated inside the hose. By distributing piezo-crystal receivers along the hose, it is possible to ensure a grouping of the seismographs and to improve the recording of reflected waves. A hose, containing these devices with 12-24 channels, is towed behind the ship carrying seismic apparatus at a shallow depth, and the reception of explosions is made by the ship under way.

Other designs of floating seismograph braids mounted in an air-filled canvas hose or in floats were developed in 1957-1958 in Baku. These use both piezo-receivers and original seismographs, the design of which is based on the use of filtered electric potential.

The presence of different types of floating braids contributed to the expansion of the scale of marine-seismic prospecting with reflected waves and its spread in deep parts of the sea. Thus, in 1957-1958, a seismic party of the VNIIGeofizika succeeded in finishing 60 kilometers of seismic profiles in the daylight of one day. Good seismograms with clear recordings of reflected waves were obtained in 1958 at depths of 600 meters. In addition, in a seismic profile down to a depth of 4-5 kilometers, there is a fully sufficient quantity of reliably determinable reflecting areas. Since 1957, the principal distances in using seismic receivers of pressure have been successfully eliminated.

The correlation method of refracted waves and the GSE method (method of deep seismic sounding), developed in the USSR by the Institute of the Physics of the Earth of the Academy of Sciences USSR, are applied for studying deep occurrences of crystallic basements and the deep layers of the Earth's crust.

Work according to the GSE method for studying deep beds of the main surface of the Earth's crust down to the Mohorovicic discontinuity was conducted, in 1956, in the Caspian Sea and, in 1957-1958, in the Pacific Ocean and the Okhotsk Sea in the transition zone between the ocean and the Asiatic continent. During the development of GSE operations in the Caspian Sea, it was found that the best method of seismic sounding at sea was by the use of shifting explosion-points and the reception of seismic oscillations by identical hydrophones on several ships stationed along the seismic profile.

Work in the Caspian Sea according to the GSE method resulted in some interesting findings. Four groups of seismic waves with different velocities were registered: (1) condensed sedimentary rock, 4.8 kilometers per second; (2) granite, 6.0 kilometers per second; (3) basalt, 6.6 kilometers per second; and (4) ultra-basalt -- the Mohorovicic discontinuity, 8.0 kilometers per second.

In view of its possibilities, marine-seismic investigations must be perfected and expanded in the future and also correctly tied in to other geophysical observations.

Marine-geophysical prospecting requires the performance of a number of auxiliary hydrographic work. During regional geophysical studies, especially at great depths, the application of echometers is necessary. Echo sounding with oscillograph recording of the reflected impulse is also useful for determining the nature of rock on the sea bottom. The coordinates of ships during geophysical measurements in the open sea are determined by radio-geodesic methods.

At present, the practice and theory of marine geology is greatly needed in the ever-growing geophysical investigations on continental shelves and in the world ocean. The further development of the theory, methods, and techniques of complex marine-geophysical works is necessary. In studying the continental shelf (down to depths of 200-250 meters), considerably greater detail and accuracy are needed. The continuation and expansion of marine-geophysical investigations is necessary in the composition of the scientific expeditions of the Academy of Sciences USSR. ("Geophysical Investigations in Marine Geology," by V. V. Fedynskiy, All-Union Scientific Research Institute of Geophysical Methods of Prospecting, Ministry of Geology and the Conservation of Natural Resources USSR, Moscow; Moscow, Izvestiya Akademii Nauk SSSR, Seriya Geologicheskaya, No 6, Jun 59, pp 3-15)

II. UPPER ATMOSPHERE

Radar Observations of Meteor Activity in Ashkhabad From October 1957 to June 1958 According to the IGY Program

"The registration of meteor activity (Subject No 34 of the Plan of Investigations of the Committee for the Conduct of the IGY under the Council of Ministers USSR) is a part of the program of observations of the International Geophysical Year.

"In this connection, points for conducting radar observations on standard apparatus with antennas facing in the same direction and the automatic registration of meteor echoes according to a single system were episodically conducted in Ashkhabad from August 1947; in the present work, we touch upon data obtained during the IGY period, from October 1957 to June 1958, inclusively. Preliminary data for the period from June to September (Yu. L. Truttse, A. Khanberdy'yev, and A. T. Belous, "Radar Observations of Meteor Activity in Ashkhabad in July-September 1957," Izvestiya Akademii Nauk Turkmenskoy SSR, No 3, 1958) and data in a somewhat different method of measuring meteor echoes on film appearing in the work of G. A. Nasyrov ("Radar Determinations of Meteor Activity in July-September 1957 in Ashkhabad, "Izvestiya Akademii Nauk Turkenskoy SSR, No 6, 1957) have already been published. Yu. L. Truttse took part in the work in October-December 1957. The work of the authors of this article was divided as follows: the radio engineering side -- A. T. Belous; and the production of measurements and the compilation of the summaries -- L. G. Astapovich.

"The observations, according to the specified subject, were conducted by the Astrophysical Laboratory of the Institute of Physics and Geophysics of the Academy of Sciences Turkmen SSR in Ashkhabad, Garden of Keshi (37 57 N, 3 hours 53 minutes 24 seconds E, at an altitude of 220 meters above sea level). From October to December 1957, the observations were carried out in the course of 419 hours and 25 minutes. Moreover, 353 meteor echoes were registered, 14 of which lasted more than one second. In view of the large amount of noise, especially in the daytime, the conditions of observation of this period should be considered insufficiently favorable. However, as of January 1959, the quality of the recording of the echoes on film improved considerably, in connection with a decrease in the amount of industrial disturbances. Their processing was also refined by means of using projector apparatus and special gauges for measuring the echo which was recorded on the motion-picture film. From January to March 1958, the observations were conducted in the course of 795 hours and 8 minutes. During this time, 868 meteor echoes were recorded, 143 of these lasting more than one second. In addition to observations according to the IGY program on world calendar days, observations on other days (according to a single program with stations in Stalinabad, Kiev, Odessa, Kazan and Tomsk) were conducted. The data cited are a summary of both programs. During the period from April to June 1958 inclusively, the total time of observations was 722 hours. In all, 1236 echoes were noted, 188 of these lasting more than one second.

"All of the observations were conducted on standard radar equipment. The following is data on the equipment: pulse power, 80 kilowatts; carrier frequency, 72 megacycles; and pulse repetition rate, 50 pulses per second. The antenna is a seven-element "wave duct" type, its center point being located at a height of two wave-lengths above the Earth's surface. The antenna is permanently fixed at an angle of 22 degrees to the plane of the horizon. The starting and switching-off of the apparatus are produced automatically with the aid of a special attachment manufactured in Ashkhabad by the staff of associates. The power sources are stabilized. The registration of echoes is realized by a photo attachment made by the Khar'kov Polytechnic Institute under the supervision of B. L. Kashcheyev. Travel rate of the film is 310 millimeters per hour. The rate was increased above the recommended rate for a more reliable selection of meteor echoes amidst disturbances. The apparatus was equipped with K. V. Kostylev's artificial meteor simulator, four marks of which make it possible to produce an estimate of the duration of the meteor echoes. Time markers are fed automatically by a separate attachment every half hour. The apparatus, as a whole, makes it possible to determine the moment of a meteor's flight, its slant range, and duration. The results of each hour and the dates of observation according to the month are presented in Table 1; the distribution according to slant range, in Table 2. In the tables, n denotes the average number per hour; n', the average number for a specific day; R is the slant range; and N is the number of meteor echoes."

Meteor Activity on 4.2-Meter Wave Length According to Observations in Ashkhabad During the IGY Period 1957-1958

October 1957 / November 1957

GMT	23	24	11	21	22	26	27	n
00-01	0	5	1	1	1	—	—	1,00
01-02	0	1	0	5	0	0	—	1,25
02-03	—	1	2	4	1	2	—	2,25
03-04	—	—	1	1	0	2	0	0,80
04-05	0	0	1	1	—	—	1	1,00
05-06	—	—	2	4	1	—	0	1,75
06-07	—	—	4	0	2	2	—	2,00
07-08	—	1	2	2	2	0	0	1,20
08-09	—	—	—	5	—	0	—	2,50
09-10	0	—	4	1	—	0	—	1,67
10-11	0	0	1	2	2	1	0	1,20
11-12	—	1	2	0	1	1	2	1,20
12-13	3	2	5	—	—	2	1	2,67
13-14	1	1	1	0	3	—	1	1,25
14-15	0	0		2	0	0	0	0,50
15-16	0	0	1	3	0	0	0	0,80
16-17	0	0	—	3	1	0	0	1,00
17-18	0	0	0	3	1	3	—	1,75
18-19	0	1	2	1	1	1	—	1,25
19-20	0	0	2	3	4	2	1	2,40
20-21	1	2	1	—	—	0	2	2,67
21-22	2	0	0	3	0	—	0	0,75
22-23	2	1	3	0	0	—	0	0,75
23-24	3	0	0	0	0	—	1	0,25
	0,89	10	1,90	2,0	1,06	0,94	0,56	

December 1958

GMT	09	10	11	12	13	14	15	16	17	18	19	20	21	22	n
00-01	—	0	2	0	0	0	1	0	—	3	1	1	1	—	0,82
01-02	—	—	0	0	—	—	—	—	—	—	0	—	—	—	—
02-03	0	—	·		—	—	—	—	—	—	—	—	—	—	—
03-04	0	—	0	1	4	0	1	—	1	0	0	0	—	0	0,64
04-05	0	—	2	0	0	0	1	—	0	1	1	0	—	1	0,55
05-06	1	—	2	4	0	1	0	—	0	0	2	0	—	0	0,91
06-07	4	—	0	2	0	2	0	—	1	0	1	1	—	1	1,09
07-08	0	—	0	1	0	1	0	—	0	1	0	0	—	0	0,27
08-09	2	—	0	2	0	0	0	—	1	1	0	0	—	0	0,55
09-10	—	—	1	0	0	0	—	—	—	0	-	—	—	—	0,20
10-11	—	—	—	·	—	—	—	—	—	—	—	—	—	—	—
11-12	-	—	0	0		0	—	—	0	—	0	0	—	0	0,00
12-13	0	—	0	0	0	0	—	0	0	—	0	0	—	1	0,10
13-14	2	—	1	0	0	1	—	1	0	—	1	0	—	1	0,70
14-15	2	—	1	0	1	0	—	0	0	—	1	0	—	0	0,50
15-16	0	—	0	0	0	—	—	0	0	—	0	0	—	0	0,00
16-17	2	0	0	0	0	—	—	1	1	—	0	2	—	0	0,50

Table 1 (continued)

GWT	09	10	11	12	13	14	15	16	17	18	19	20	21	22	n
17–18	1	1	0	1	—	—	—	—	0	—	—		—	—	0,00
18–19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
19–20	5	4	5	7	3	0	1	0	—	0	2	1	0	2	2,31
20–21	3	5	2	1	0	0	2	0	0	0	1	0	0	1	1,07
21–22	1	1	0	2	0	0	0	0	0	0	1	2	0	1	0,57
22–23	1	0	1	0	0	0	0	—	4	0	0	0	1	1	0,51
23–24	1	0	1	0	0	0	0		3	0	0	0	0	—	0,12
	1,39	1,38	0,56	1,00	0,14	0,29	0,50	0,22	0,65	0,46	0,58	0,39	0,33	0,56	

January 1958

GWT	01	02	03	04	05	06	10	11	14	15	17	19	20	24	25	28	29	31	n
00–01	—	0	1	6	0	0	—	0	-	1	—	—	—	—	0	—	0	—	0,89
01–02	—	1	—	3	0	1	—	-	—	—	—	—	0	—	0	—	—	—	0,83
02–03	—	—	—	—	—	—	—	0	—	1	0	—	1	—	2	—	0	—	0,67
03–04	—	1	0	0	0	0	—	0	—	1	0	—	0	—	—	—	0	—	0,20
04–05	—	0	0	1	0	0	—	3	—	0	0	—	0	—	1	—	1	—	0,55
05–06	0	0	0	3	1	0	—	2	—	0	2	—	0	—	1	—	1	—	0,83
06–07	1	0	1	0	0	0	—	0	—	1	0	0	0	—	0	—	0	—	0,23
07–08	0	0	1	1	0	—	—	1	—	0	—	—	1	—	0	—	1	—	0,50
08–09	—	1	0	0	0	-	—	0	—	0	—	—	—	—	0	—	0	—	0,13
09–10	1	0	—	0	—	—	—	—	0	—	—	—	0	—	—	0	—	0	0,14
10–11	1	—	—	—	—	—	1	—	2	—	—	—	0	0	—	0	—	0	0,57
11–12	0	0	1	0	0	2	1	—	0	—	—	—	0	0	—	0	—	0	0,33
12–13	1	0	2	0	0	0	1	—	0	—	—	—	—	1	—	0	—	0	0,15
13–14	0	1	0	1	0	0	1	—	0	—	—	0	—	1	—	0	—	0	0,33
14–15	0	0	0	1	0	0	0	—	0	—	—	0	0	0	—	—	—	1	0,17
15–16	0	1	2	0	0	0	0	-	0	—	—	—	0	1	—	—	—	0	0,36
16–17	0	0	1	0	0	0	1	—	—	—	—	—	—	0	—	0	—	0	0,20
17–18	0	0	0	—	0	—	—	—	—	—	—	0	0	0	—	—	—	—	0,00
18–19	—	—	—	—	—		0	—	0		—	0	0	—	—	0	—	0	0,00
19–20	0	0	1	2	0	0	1	—	0	—	—	1	0	1	—	—	—	1	0,58
20–21	1	0	2	0	1	1	1	—	0	—	—	0	2	1	—	—	—	1	0,83
21–22	1	0	5	1	2	1	0	—	0	—	—	0	0	0	—	1	—	1	0,92
22–23	0	0	1	0	0	2	0	—	0	—	—	0	1	0	—	2	—	0	0,46
23–24	0	2	3	1	0	-	0	—	0	—	—	1	0	1	—	0	—	1	0,75
	0,35	0,33	1,05	1,00	0,20	0,41	0,54	0,75	0,15	0,50	0,40	0,20	0,26	0,46	0,50	0,30	0,38	0,35	

February 1958

GWT	01	03	04	07	08	10	14	15	18	19	23	24	26	n
00–01	—	—	1	—	1	—	-	0	8	0	—	0	0	1,43
01–02	1	—	—	—	-	—	—	-	0	4	—	—	3	2,00
02–03	1	—	0	-	1	—	—	1	0	0	—	—	3	0,86
03–04	0	—	1	—	0	—	—	1	0	—	—	—	1	0,50
04–05	[illegible]	—	0	—	—		—	0	2	—	—	—	0	1,00
05–06	4	-	2	—	—	0	—	—	1	—	—	—	0	1,40
06–07	1	-	1		—	1	—	—	0	—	—	—	4	1,10
07–08	2	—	0	—	-	0	—	—	—	—	—	—	0	1,50
08–09	—	—	0	—	—	1	—	—	—	—	—	—	—	0,50
09–10	—	1	—	—	—	2	—	—	2	1	0	—	3	1,50
10–11	—	0	—	—	—	1	—	—	0	1	—	—	2	0,80
11–12	—	0	—	—	—	1	0	—	1	0	0	—	1	0,13
12–13	-	3		0	—	0	0	—	2	0	0	—	0	0,63
13–14	-	0		0		-	2	—	1	1	0	—	0	0,5[illegible]

Table 1 Continued

GWT	01	03	04	07	08	10	11	15	18	19	23	24	26	n
14–15	—	0	—	0	—	2	1	—	1	0	1	—	1	0,75
15–16	—	0	—	0	—	0	0	—	—	—	0	—	1	0,17
16–17	—	0	—	1	—	0	—	—	—	—	0	—	—	0,25
17–18	—	—	—	—	—	0	—	—	0	2	—	—	2	1,00
18–19	—	0	—	0	—	0	1	—	1	0	0	—	1	0,37
19–20	—	0	—	0	—	0	5	—	0	0	0	—	0	0,63
20–21	—	0	—	0	—	—	2	—	0	0	1	—	0	0,43
21–22	—	0	—	0	—	0	0	—	2	0	2	—	0	0,50
22–23	—	0	—	0	—	0	2	—	0	0	0	—	1	0,37
23–24	—	0		0	—	0	2	—	0	0	1	—	1	0,50
	1,71	0,26	0,5[illegible]	0,0[illegible]	0,06	0,17	1,30	0,50	1,05	0,56	0,38	-	0,09	

March 1958

GWT	02	03	05	06	10	11	14	15	16	18	19	20	21	22	23	24	25	26	28	30	31	n
00–01	—	1	0	—	—	1	—	5	—	—	—	2	—	1	1	1	2	1	—	5	1	1,75
01–02	—	—	1	5	—	—	—	0	2	—	1	2	1	3	3	2	0	2	—	1	1	1,72
02–03	—	1	5	3	—	—	—	1	2	—	2	2	1	1	2	0	2	0	1	3	1	1,69
03–04	—	0	3	1	—	—	—	5	3	—	3	4	1	—	1	1	0	1	0	2	2	1,80
04–05	—	2	6	4	—	—	—	1	1	—	2	0	6	—	—	—	—	—	2	1	4	2,90
05–06	—	1	4	2	—	—	—	5	4	—	1	0	-	—	2	—	—	—	1	0	3	2,00
06–07	—	2	6	1	—	—	—	—	7	—	1	3	2	—	3	—	—	-	0	0	3	2,52
07–08	—	0	9	—	—	—	—	[illegible]	1	—	3	1	0		0	—	1	—	—	0	1	1,41
08–09	—	2	—	—	—	—	—	—	—	—	—	—	0	—	1	—	—	—	1	1	3	1,33
09–10	—	—	0	—	—	—	—	—	0	1	1	1	2	—	0	—	—	—	1	2	4	1,70
10–11	0	—	5	—	—	—	0	—	2	1	0	—	0	2	1	—	—	—	0	0	0	0,92
11–12	0	—	0	—	—	—	5	2	5	1	1	0	1	3	0	—	—	—	1	0	3	1,50
12–13	0	—	2	—	—	—	1	3	0	1	1	0	—	0	—	0	—	—	0	3	0	0,85
13–14	0	—	1	—	—	—	0	2	1	0	0	1	0	3	0	1	—	0	1	1	1	0,75
14–15	0	—	1	—	—	—	3	0	0	1	0	0	0	1	1	5	1	3	0	0	1	1,00
15–16	0	—	—	—	—	—	1	1	0	0	0	0	1	2	1	5	0	0	0	—	1	0,80
16–17	0	—	—	—	—	—	4	0	—	—	—	—	0	1	1	1	0	0	—	0	—	0,70
17–18	—	—	3	—	—	—	—	-	1	1	1	0	0	1	1	0	0	1	1	2	0	1,07
18–19	0	—	2	—	1	—	6	2	1	1	0	4	0	3	1	3	1	1	1	0	1	1,72
19–20	0	—	7	—	9	—	4	2	1	2	2	3	1	1	2	5	2	2	0	1	0	2,63
20–21	0	—	1	—	3	—	4	6	5	2	3	3	—	3	2	—	1	2	2	1	1	2,42
21–22	4	—	3	—	9	—	2	5	2	1	4	1	2	1	1	0	0	0	1	5	0	2,28
22–23	1	—	0	—	4	—	5	1	3	0	1	0	0	0	0	2	0	0	0	2	0	1,06
23–24	1	—	2	—	0	—	2	0	0	1	3	5	0	0	2	3	1	-	3	0	1	1,39
	0,46	1,12	2,44	2,63	4,35	1,0	2,50	2,62	2,32	2,43	1,57	1,53	0,90	1,53	1,31	1,93	0,73	0,93	0,81	1,30	1,39	

May 1958

GWT	01	03	04	05	06	07	11	14	16	17	19	20	21	25	26	30	n
00–01	—	—	—	0	—	1	—	—	0	0	—	1	—	—	0	2	0,57
01–02	—	—	—	2	1	1	—	—	1	1	1	1	1	—	—	0	1,00
02–03	3	—	—	3	1	·	—	—	2	2	0	1	2	-	0	0	1,40
03–04	3	—	—	1	1	—	—	—	2	2	2	2	3	—	1	2	1,90
04–05	1	0	—	1	—	—	—	—	2	1	1	3	2	—	2	6	1,90
05–06	0	2	1	2	—	0	—	—	2	7	1	1	6	—	5	1	2,33
06–07	4	2	1	0	—	1	—	—	0	4	0	1	1	—	1	0	1,25

GWT	01	03	04	05	06	07	11	14	16	17	19	20	21	25	26	30	
07–08	—	1	1	0	.	..	..	-	1	1	0	2	1	—	0	0	0,70
08–09	—	—	1	—	1	—	—		0	1	0	0	—	—	0	0	0,38
09–10	—	2	1	0	0	0	-	0	0	1	0	1	1	-	0	—	0,50
10–11	—	0	0	0	1	0	1	2	1	1	1	1	0	-	0	—	0,62
11–12	—	0	1	1	1	1	0	0	1	3	0	1	1	0	1	—	0,79
12–13	—	2	0	1	.	..	1	1	1	1	2	0	0	0	0	—	0,75
13–14	—	0	0	3	3	-	1	0	1	3	0	0	0	0	1	—	0,92
14–15	—	0	0	1	—	—	0	0	—	1	2	1	1	0	0	—	0,55
15–16	—	0	0	1	—	—	0	1	—	2	0	1	0	3	1	—	0,82
16–17	—	0	0	2	1	0	0	1	.	2	-	0	1	0	0	—	0,58
17–18	—	—	-	0	1	0	2	0	3	1	0	0	0	-	0	—	0,64
18–19	—	—	—	0	2	2	1	1	2	1	1	0	0	—	0	—	0,91
19–20	—	—	—	0	0	1	0	0	3	2	0	0	2	0	2	—	0,83
20–21	—	-	0	1	1	1	2	3	0	5	0	0	0	2	1	—	1,23
21–22	—	—	0	0	2	3	—	1	2	1	2	0	2	0	0	—	1,08
22–23	—	—	1	0	2	0	—	2	0	0	0	2	4	0	5	—	1,33
23–24	—	—	2	1	—	0	—	-	1	0	0	0	0	1	1	—	0,60
	2,20	0,75	0,56	0,87	1,20	0,73	0,72	0,86	1,19	1,80	1,59	0,79	1,27	1,84	0,91	1,22	

June 1958

GWT	02	03	15	16	17	18	19	20	21	22	23	24	28	29	
00–01	—	2	0	1	2	1	0	2	4	4	1	3	—	5	2,08
01–02	—	1	1	0	2	3	1	1	2	8	0	4	—	4	2,25
02–03	—	1	5	0	2	0	2	7	7	2	4	8	—	2	2,33
03–04	—	2	—	6	4	2	4	8	11	4	3	3	—	12	5,36
04–05	—	15	—	7	9	5	—	4	—	10	6	4	—	13	8,11
05–06	—	11	3	2	11	5	4	2	1	7	0	2	—	20	5,67
06–07	—	1	1	0	2	2	3	0	1	6	1	3	—	8	2,33
07–08	—	0	0	0	2	2	1	0	0	1	1	2	—	1	0,83
08–09	—	0	0	0	1	2	2	0	1	8	3	1	—	2	1,67
09–10	1	—	0	0	3	0	0	0	2	2	3	0	3	—	1,17
10–11	0	—	0	2	4	0	1	1	0	2	1	1	1	—	1,08
11–12	2	—	0	0	2	0	1	—	—	—	3	0	1	—	1,00
12–13	0	—	0	—	—	—	—	—	—	1	3	0	0	—	2,67
13–14	1	—	0	1	0	3	5	—	0	1	0	0	1	—	1,09
14–15	2	—	1	0	0	2	1	1	0	2	0	0	1	—	0,83
15–16	1	—	1	0	0	0	0	0	0	2	2	3	0	—	0,75
16–17	1	—	0	1	1	0	0	0	0	2	1	0	2	—	0,67
17–18	7	—	0	1	1	0	4	0	1	1	5	2	3	—	2,08
18–19	1	—	1	3	5	1	1	0	0	1	2	1	0	—	1,33
19–20	2	—	1	0	1	1	1	—	1	1	—	2	3	—	1,30
20–21	2	-	—	—	2	0	2	6	—	..	—	7	4	—	3,29
21–22	..	—	1	1	5	3	5	7	1	1	5	6	2	—	3,36
22–23	2	—	0	0	7	2	5	10	1	0	3	7	2	—	3,25
23–24	—	—	1	1	2	2	0	5	4	2	2	4	6	—	2,64
	1,69	3,69	0,76	1,18	2,96	1,56	1,96	2,70	1,85	3,09	2,23	2,89	1,91	7,15	

Distribution of Meteor Echoes According to Slant Range R

(III--October-December 1957, I--January-March 1958, II--April-June 1958)

R, km	III	I	II	R, km	III	I	II
60--69	0	7	9	210--219	18	43	42
70--79	5	16	21	220--229	16	42	77
80--89	9	17	27	230--239	20	38	24
90--99	12	15	22	240--249	15	36	69
100--109	10	22	20	250--259	18	22	48
110--119	11	31	31	260--269	5	20	28
120--129	20	33	39	270--279	4	25	39
130--139	17	41	22	280--289	2	9	35
140--149	27	60	74	290--299	4	8	28
150--159	21	72	123	300--309	0	6	18
160--169	25	56	100	310--319	0	4	11
170--179	27	88	156	320--329	0	4	8
180--189	25	73	112	330--339	0	3	6
190--199	18	52	102	340--349	0	0	3
200--209	13	31	51	350--370	0	1	1

("Radar Observations of Meteor Activity in Ashkhabad From October 1957 to June 1958 According to the IGY Program," by A. T. Belous and L. G. Astapovich, Institute of Physics and Geophysics Academy of Sciences Turkmen SSR; Izvestiya Akademii Nauk Turkmenskoy SSR, No 2, 1959, pp 96-101)

III. METEOROLOGY

"Kobal't" Radar Station Built for Tropospheric Sounding

In 1956, the TsAO (Central Aerological Observatory), of the Main Administration of the Hydrometeorological Service under the Council of Ministers USSR, designed and built an installation for radar sounding of the troposphere at the radio station "Kobal't," the modulator and transmitter of which were modernized to increase the power of the sounding pulse.

The 20-meter reinforced concrete reflector of the antenna system was built on a packed sand base; the supporting columns are along the periphery. The concrete surface was metallized with zinc by means of a Schoope process. The two-slot radiator of the antenna installation of the "Kobal't" station was replaced by a horn-type radiator with a radiation pattern of about 120 degrees (along a line of 0.1 power).

The hermetically sealed housing of the high-frequency section of the "Kobal't" station makes it possible to avoid the use of a special waveguide. The high-frequency section is in the dome reflector, with the horn radiator in the focus of a paraboloid. Two towers at the edge of the paraboloid support the four cables connected to the assembly rack of the radio-frequency section.

During the summer of 1956, experiments were conducted with the troposphere radar installation, and the data collected were compared with data collected by conventional methods. Some measurement data and photographs are given ("Radar Sounding of the Troposphere," by V. V. Kostarev, Central Aerological Observatory; Moscow, Trudy Tsentral'noy Aerologicheskoy Observatorii, No 20, 1958, pp 3-16)

Additional information on and photographs of the modernized "Kobal't" weather radar station are given in the same issue of the above-mentioned source in an article entitled "Improving the Effectiveness of the Image of Meteorological Targets With the Radio Locator "Kobal't'," by V. D. Stepanenko, pages 67-72.]

Cloud Studies With Radar Used in Forming Storm Warning Net

An analysis of weather radar data collected in 1951-1955 by the Radiometeorological Laboratory of the Main Geophysical Observatory imeni A. I. Voyeykov has revealed the close connection between the character of radar images and the three-dimensional distribution of clouds under certain synoptical conditions. The configuration and location of radar display patterns indicate whether cloud-like intramass or frontal precipitations take place at a given moment, and the motion of the latter determines with what atmospheric fronts they are associated, i.e., with a moving or a stationary front.

A study of radar display patterns obtained in 1954-1955 by the Radio-meteorological Laboratory of the Main Geophysical Observatory has provided criteria for the classification of cloudbursts and thunderstorms; these criteria are based on the vertical spread and on the altitude in relation to that of the -14° isotherm.

A new code is suggested for the telegraphic transmission of the information on cloud distribution and characteristics of storm conditions and shower activity. ("Using the Results of Radar Studies of Clouds for the Improvement of the Work of the Network of Storm Warning Stations," by N. F. Kotov, Main Geophysical Observatory imeni A. I. Voyeykov; Moscow, Trudy Tsentral'noy Aerologicheskoy Observatorii, No 20, 1958, pp 17-25)

IV. OCEANOGRAPHY

Third Voyage of the Severyanka

An account of the third voyage of the Severyanka, research submarine of the All-Union Scientific Research Institute of the Fish Economy and Oceanography, by V. Azhazha, Chief of the Laboratory of Technical Instruments for Underwater Research, appeared in the 24 May 1959 issue of Sovetskiy Flot.

The Severyanka, as is known, made its first voyage in December 1958 in the region of Murmansk and its second voyage in the herring fishing regions of the North Atlantic. Both of these voyages resulted in much new and interesting scientific material. For example, the 24-hour behavior of Atlantic herring was studied. A number of oceanographic investigations were conducted. It was impossible, however, to observe the operation of the variable-depth trawl used because of the poor visibility under water during the polar night. This particular problem was solved only at the time of the third expedition, which has just been completed. Scientists aboard also found out how bottom fish react to danger and tested the effectiveness of finding fish with hydroacoustical instruments.

The task of increasing the catch of fish, which was established in the Seven-Year Plan by the 21st Party Congress, requires the scientists and the workers of the fishing industry to raise the operational efficiency of the trawling fleet. In this respect, the tools of the catch have many untapped possibilities.

The trawl itself is a complex engineering work, consisting of a number of mutually interacting parts. Engineers designing trawls do not have the possibility of inspecting their work under water. This was the task which fell to the Severyanka.

The Severyanka put out to sea in April, a time when natural illumination is already high. On a sunny day, it is possible to read a newspaper at a depth of 100 meters by the light entering through one of the viewing ports. This was the time selected for observing the operation of a trawl. The problem required close and delicate manuevering in direct proximity to the moving trawl.

The submarine remained directly below the trawl for several hours while engineers observed and made motion pictures of its operation. In all, the studies extended over several days. The results of the observations are now being processed. The will aid in the design of new types of trawls.

At times, the Severyanka settled to the bottom of the sea for conducting observations of marine life.

Work with the hydroacoustical instruments made it possible to measure the zones of action of the echometers, that is, to explore the space around the submarine, which is penetrated by ultrasonic energy and within the limits of which it is possible to detect schools of fish and other objects.

The third expedition, says Azhazha, is but another link in the program of operations of the Severyanka, which, it is calculated, will be completed in several years. Now, preparations for a fourth expedition are being conducted in the laboratories of the All-Union Scientific Research Institute of the Fish Economy and Oceanography. ("Trawl Above the Severyanka," by V. Azhazha; Moscow, Sovetskiy Flot, 24 May 59, p 4)

V. ARCTIC AND ANTARCTIC

Soviet Research in the Antarctic

Radiosonde observations of the atmosphere, conducted by Soviet scientific stations in Antarctica, revealed that the cold layer of air is only about one kilometer high and that, near the boundary of this layer, the air is 20-30 degrees centigrade warmer. Accordingly, the severe frosts observed near the surface of Antarctica are not really sufficient reason to believe that, under the influence of Antarctica, the climate of the entire Southern Hemisphere has become colder than that in the Northern Hemisphere. Moreover, when the cold air circulates and flows in the direction of the ocean, it descends along the antarctic slope and is dynamically heated. This partly explains the relatively warm climate on the coast, where, even in the winter, the temperature is usually not below 15-25 degrees centigrade. The reason for the cold climate of the Southern Hemisphere must be sought in the small continental area of that hemisphere; a greater land area would help to warm the air considerably in the summer.

However, Antarctica plays an important role in the balance of radiant heat of the atmosphere. During the polar night, the upper atmosphere above Antarctica cools off considerably, i.e., down to minus 80-90 degrees centigrade. On the other hand, during the summer the upper atmosphere warms up to as high as 30 degrees centigrade. Such a marked seasonal fluctuation of temperature in the upper atmosphere has not been observed anywhere else. This is reflected in the seasonal fluctuations of atmospheric pressure and circulation. Thus, we find in Antarctica one of the keys to understanding the processes connected with strong fluctuations of weather and climate.

During the cold season, the storm cyclones originate and circulate, one after another, in the temperate zones of the Southern Hemisphere, frequently reaching the continent of Antarctica. G. V. Gruza, scientific associate of the Central Asian Hydrometeorological Institute, who worked with the Third Antarctic Expedition, traced the movement of cyclones and calculated that the energy of atmospheric circulation in the Southern Hemisphere is 2 1/2 times higher than that in the Northern Hemisphere. Part of this energy is transferred by air currents to the Northern Hemisphere, where it feeds the atmospheric circulation.

During the traverse to the pole of relative inaccessibility, the thickness of the ice and the form of the subglacial relief were determined by methods of seismic sounding and gravimetry. Almost along the entire distance, the ice thickness was over 2.5 kilometers.

In the central regions of Antarctica, between Sovetskaya and the pole of relative inaccessibility, there is a high-mountain region with peaks reaching 3.5 kilometers above sea level, all of which is hidden below the ice cover. The mountains are covered by a 500-meter layer of ice.

Geophysicists have collected abundant material in the study of the ionosphere, cosmic rays, auroras, terrestrial electric currents, earthquakes, and many other phenomena. The study of terrestrial magnetism led to the compilation of more precise magnetic charts. The geologists have also made their contribution to science by studies of the structure of the antarctic continent and exploration of existing deposits.

The Fourth Antarctic Expedition, now in operation, intends to continue its advance into the interior of the continent. -- V. Bugayev, chief of aerometeorological detachment of the Third Antarctic Expedition and Director of the Institute of Mathematics, Academy of Sciences Uzbek SSR. ("Soviet Scientists in Antarctica," Tashkent, Pravda Vostoka, 3 Jun 59)

Discussion of Antarctic Research Results

A discussion of the results of scientific research, conducted by Soviet polar scientists in Antarctica under the IGY program, took place in the Presidium of the Academy of Sciences USSR.

A report on the results of the work of the Third Antarctic Expedition was given by its chief, Ye. I. Tolstikov, Candidate of Geographical Sciences. Other reports on individual sections of the scientific program were given by Prof V. A. Bugayev, chief of the aerometeorological detachment; O. G. Sorokhtin, seismic researcher; K. V. Lapkin, physician at the station Vostok; and Prof M. G. Ravich, member of the Fourth Antarctic Expedition.

Soviet scientists collected sufficient material for compiling the first hypsometric map of a considerable portion of East Antarctica; they studied the ice thickness over a distance of several thousand kilometers and determined the nature of the subglacial relief. A vast subglacial mountainous region, extending over 1,000 kilometers, occupies the central portion of Antarctica.

The members of the expedition obtained interesting data on the climate of the central regions of the continent. They compiled a map of the map of the mean annual isotherms of East Antarctica and determined that the region including the stations Vostok, Sovetskaya, and the Pole of Relative Inaccessibility is the coldest place in Antarctica. The "cold pole" of the Earth is the station Vostok. On 25 August 1958, the lowest temperature of the air near the surface, i.e., minus 87.4 degrees centigrade, was recorded at this point. Based on observations of the movement of the antarctic ice cover, quantitative data were obtained regarding the amount of ice breaking off from the ice cap into the sea. It was estimated that the region of the coast between 82 and 110 E, covering 2,435 kilometers, annually throws 448 square kilometers of ice into the sea.

Materials have been collected in the study of atmospheric electricity, the magnetic field of the Earth, ionospheric phenomena, cosmic rays, earth currents, auroras, gravimetry, and seismology. These data will make it possible to discover the nature of many geophysical processes, both in Antarctica and on the whole Earth. Observations have been conducted on the behavior of the human organism under conditions of high altitudes and low temperatures in the interior of the continent.

It was emphasized at the meeting of the Presidium of the Academy of Sciences USSR that one of the most valuable achievements of the Third Antarctic Expedition was the work on the glaciological cross-section from the Mirnyy observatory to the pole of relative inaccessibility (a distance of over 2,100 kilometers) and the establishment of a temporary scientific station in this region.

Soviet polar scientists have been working in close contact with scientists of other countries, and there has been a regular exchange of scientific information.

The meeting of the Presidium was attended by representatives of a number of scientific research institutes of the Academy of Sciences USSR, the Ministry of the Maritime Fleet, the Main Administration of the Hydrometeorological Service, and other institutions. Academician A. N. Nesmeyanov, President of the Academy of Sciences USSR; academicians V. V. Shuleykin and D. I. Shcherbakov; and A. A. Afanas'yev, Deputy Minister of the Maritime Fleet, took part in the discussions. A. N. Nesmeyanov stated in his speech that the work of members of the Soviet Antarctic Expeditions, performed under conditions of extreme hardship, deserves the highest praise.

The Presidium of the Academy of Sciences USSR noted that the pledges of the Soviet Union for the IGY program are being fulfilled successfully; it gave a high evaluation to the activity of the antarctic expeditions and approved the general direction of future work in the study of the Antarctic. ("Polar Scientists Have Earned High Praise"; Moscow, Vodnyy Transport, 16 Jun 59)

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